

WHAT IS CLAIMED IS:

1. A method of manufacturing a liquid crystal display, comprising the steps of:

5 providing a first alignment layer on a first substrate;

rubbing said first alignment layer such that said first alignment layer has a first pretilt angle associated therewith;

providing a second alignment layer on a second substrate;

exposing said second alignment layer to light such that said second alignment layer has at least one second pretilt angle associated therewith; and

providing a liquid crystal material between said first and second substrates.

2. A method in accordance with claim 1, wherein said first alignment layer comprises polyimide.

20

3. A method in accordance with claim 1, wherein said second alignment layer comprises polysiloxane based materials.

25

4. A method in accordance with claim 1, wherein

10
15
20
25
~~RECORDED IN U.S. PATENT AND TRADEMARK OFFICE~~
said light includes linearly polarized light.

5. A method in accordance with claim 1, wherein
said exposing step further comprises the steps of:

generating unpolarized light; and

transmitting said unpolarized light through a
polarizer to generate said linearly polarized light.

6. A method in accordance with claim 5, wherein
said linearly polarized light includes linearly polarized
ultraviolet light.

7. A method in accordance with claim 1, wherein
said light is incident substantially perpendicular to
said second alignment layer.

8. A method in accordance with claim 1, wherein
said light comprises ultraviolet light.

9. A method in accordance with claim 1, wherein
said exposing step includes a single exposure to said
light.

10. A method in accordance with claim 1, wherein
25 a plurality of pretilt angles are associated with said

second alignment layer after said exposing step, said plurality of pretilt angles being oriented in respective pretilt directions, said providing step further comprising the step of injecting said liquid crystal material between said first and second substrates so as to select ones of said plurality of pretilt angles oriented in a single direction.

11. A method in accordance with claim 7, wherein said photo-incidation is further comprising the step of exposing additional light to select ones of said plurality of pretilt angles oriented in a single direction.

12. A method in accordance with claim 11, wherein said additional light comprises unpolarized light.

13. A method in accordance with claim 12, wherein said unpolarized additional light is obliquely incident to the second alignment layer.

14. A method in accordance with claim 1, wherein said exposing step is comprising the steps of; exposing said second alignment layer to a polarized light in the perpendicular direction; and

exposing said second alignment layer to a nonpolarized light in the oblique direction.

15. A method in accordance with claim 1,
5 wherein said exposing step is comprising the steps of;

exposing said second alignment layer to a nonpolarized light in the oblique direction; and

exposing said second alignment layer to a polarized light in the perpendicular direction.

16. A method in accordance with claim 1, wherein
said exposing steps further comprises the steps of:

exposing said second alignment layer to a first light such that a plurality of pretilt angles are associated with said second alignment layer, said plurality of pretilt angles being oriented in respective pretilt directions,

exposing a first portion of said second alignment layer to a second light so as to select ones of said pretilt angles associated with said first portion oriented in a first direction; and

exposing a second portion of said second alignment layer to a third light so as to select ones of said pretilt angles associated with said second portion oriented in a second direction.

TOP SECRET - DEFENSE

17. A method in accordance with claim 16, wherein
said first light includes linearly polarized light.

5 18. A method in accordance with claim 16, wherein
said first light is incident substantially perpendicular
to a surface of said second alignment layer.

19. A method in accordance with claim 16, wherein
said second light and/or said third light
include/includes unpolarized light.

20. A method in accordance with claim 19, wherein
said second light and/or said third light
are/is incident obliquely to said surface of said second
alignment layer.

21. A method in accordance with claim 1, further
comprising the steps of:

20 providing a third alignment layer on a portion of
said first alignment layer;

rubbing said third alignment layer such that said
third alignment layer has a third pretilt angle
associated therewith.

25 22. A method in accordance with claim 21, wherein

said third alignment layer has a pretilt angle forming characteristics differing than the first alignment layer's.

5 23. A method in accordance with claim 21, wherein said third pretilt angle has a magnitude greater than said first pretilt angle.

24. A method in accordance with claim 1, further comprising the steps of:

exposing a first portion of said second alignment layer to a first dose of a first light such that a first plurality of pretilt angles having respective pretilt directions are associated with said first portion of said second alignment layer, and

20

exposing a second portion of said second alignment layer to a second dose of said first light such that a second plurality of pretilt angles having respective pretilt directions are associated with said second portion of said second alignment layer.

25 25. A method in accordance with claim 24, further comprising the steps of:

exposing said first portion of said second alignment layer to a first dose of a second light to select ones of

10
said pretilt angles associated with said first portion of
said second alignment layer; and

5
exposing said second portion of said second alignment
layer to a second dose of said second light to select
ones of said pretilt angles associated with said second
portion of said second alignment layer.

26. A method in accordance with claim 24, wherein
said first light includes linearly polarized light.

27. A method in accordance with claim 28, wherein
said first light is incident substantially perpendicular
to said surface of said second alignment layer.

20
28. A method in accordance with claim 24, wherein
said first plurality of pretilt angles each have a
magnitude greater than a magnitude of each of said second
plurality of pretilt angles.

29. A method in accordance with claim 25, wherein
said second light includes unpolarized light.

25
30. A method in accordance with claim 25, wherein
said second light is incident obliquely to said surface
of said second alignment layer.

5

31. A method in accordance with claim 24, wherein said first light is supplied to said second alignment layer through a plate having a first part aligned with said first portion of said substrate and having a first transmissivity, and a second part aligned with said second portion of said second alignment layer and having a second transmissivity.

100-204-100-055
100-204-100-055
100-204-100-055
100-204-100-055
100-204-100-055

32. A method in accordance with claim 25, wherein said second light is supplied to said second alignment layer through a plate having a first part aligned with said first portion of said second alignment and having a first transmissivity, and a second part aligned with said second portion of said second alignment layer and having a second transmissivity.

20

33. A method in accordance with claim 1, wherein said exposure step further comprises the steps of:

exposing a first portion of said second alignment layer to a first light such that a first pretilt angle oriented in a first direction is associated with said first portion of said second alignment layer;

25

exposing a second portion of said second alignment layer to a second light such that a second pretilt angle oriented in a second direction is

associated with said second portion of said second alignment layer,

exposing a third portion of said second alignment layer to a third light such that a third pretilt angle oriented in a third direction is associated with said third portion of said second alignment layer; and

exposing a fourth portion of said second alignment layer to a fourth light such that a fourth pretilt angle oriented in a fourth direction is associated with said fourth portion of said second alignment layer.

34. A method in accordance with claim 33, wherein at least ones of said lights includes unpolarized light, the lights including the first light, the second light, the third light, and fourth light.

35. A method in accordance with claim 34, wherein at least ones of said lights is incident obliquely to said surface of said second alignment layer the lights including the first light, the second light, the third light, and fourth light.

36. A method in accordance with claim 1, wherein the exposing step is comprising the steps of:

exposing a first portion of said second alignment layer to a first polarized light in the first perpendicular direction; and

5 exposing a second portion of said second alignment layer to a second polarized light in the second perpendicular direction

37. A method in accordance with claim 36, wherein the exposing step is further comprising the steps of:

exposing a first portion of said second alignment layer to a first unpolarized light in the first oblique direction; and

exposing a second portion of said second alignment layer to a second unpolarized light in the second oblique direction.

38. A method in accordance with claim 36, wherein the exposing step is further comprising the steps of:

20 exposing a first area of a first portion of said second alignment layer to a first unpolarized light in a first oblique direction;

exposing a second area of a first portion of said second alignment layer to a second unpolarized light in a second oblique direction and;

25 exposing a first area of a second portion of said

second alignment layer to a third unpolarized light in a
third oblique direction; and

exposing a second area of a second portion of
said second alignment layer to a fourth unpolarized light
5 in a fourth oblique direction.

39. A method of manufacturing a liquid crystal
display, comprising the steps of:

coating a first substrate with a first alignment
layer;

rubbing said first alignment layer to impart a
first alignment direction, a first pretilt angle
direction and a first pretilt angle magnitude;

coating a second substrate with a second
alignment layer;

exposing said second alignment layer to impart a
second alignment direction, a plurality of second pretilt
angles each having a second pretilt angle magnitude and
oriented in a plurality of pretilt angle direction; and

20 injecting liquid crystal material between said
first and second substrates to select those of said
plurality of pretilt angles oriented in one of said
pretilt angle directions.

SEARCHED INDEXED
SERIALIZED FILED
APR 15 1987
FBI - LOS ANGELES

20
25

40. A method of manufacturing a liquid crystal

cell in accordance with claim 39, wherein said first alignment layer includes polyimide.

5 cell in accordance with claim 39, wherein said second
alignment layer includes a polysiloxane based material.

42. A method of manufacturing a liquid crystal cell in accordance with claim 39, wherein during said exposing step, said light is incident substantially perpendicular to said second alignment layer.

43. A method of manufacturing a liquid crystal cell in accordance with claim 39, wherein said light comprises ultraviolet light.

20 ultraviolet light.

ultraviolet light.

25 layer to said light.

46. A method of manufacturing a liquid crystal cell in accordance with claim 39, wherein said first pretilt angle direction is different from said second pretilt angle direction.

5

47. A liquid crystal display device comprising:
a first substrate;
a rubbed layer provided on said first substrate;
a second substrate;
a photo-aligned layer provided on said second substrate; and
liquid crystal material provided between said first and second substrates.

48. A liquid crystal display device in accordance with claim 47, wherein said rubbed layer comprises polyimide.

20 49. A liquid crystal display device in accordance with claim 47, wherein said photo-aligned layer comprises a polysiloxane based material.

25 50. A liquid crystal display device in accordance with claim 47, wherein first molecules of said liquid crystal material adjacent said rubbed layer are aligned

in a first direction, the first direction having a first pretilt angle and a first pretilt angle direction associated with said rubbed layer.

5 51. A liquid crystal display device in accordance with claim 47, wherein second molecules of said liquid crystal material adjacent said photo-aligned layer are aligned in a second direction, the second direction having a second pretilt angle and a second pretilt angle direction associated with said photo-aligned layer.

52. A liquid crystal display device in accordance with claim 47, wherein said first pretilt angle and/or said second pretilt angle are/is larger than 60°.

53. A liquid crystal display device in accordance with claim 52, wherein said first pretilt angle and/or said second pretilt angle are/is 75° - 87°.

20 54. A liquid crystal display device in accordance with claim 47, wherein said first pretilt angle direction is substantially parallel with said second pretilt angle direction.

55. A liquid crystal display device in accordance with claim 47, wherein said first pretilt angle direction is different with said second pretilt angle direction.

5 56. A liquid crystal display device in accordance with claim 55, wherein said first pretilt angle direction is substantially perpendicular to said second pretilt angle direction.

10 57. A liquid crystal display device in accordance with claim 55, wherein said first pretilt angle direction is substantially anti-parallel to said second pretilt angle direction.

15 58. A liquid crystal display device in accordance with claim 47, wherein pluralities of liquid crystal molecules are provided adjacent respective portions of said photo-aligned layer, each plurality of liquid crystal molecules having a corresponding pretilt angle and pretilt direction.

20

25

Abd B4>